Assessment of the benefit of hypnosis in reducing 4DCT scan artifacts: preliminary results from the Hypno-4D trial

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Introduction

In stereotactic body radiotherapy (SBRT) under free breathing, 4DCT is mandatory for treatment planning. However, irregular breathing can cause severe image artifacts, affecting tumor volume accuracy, normal lung exposure, and even local control (1,2). Approaches such as audio-visual respiratory coaching exist to regularize breathing but require additional and costly devices. At our institution, hypnosis in radiotherapy is well established to relax some anxious patients and children. Studies have also shown that listening to a hypnotic recording can regulate breathing rate and amplitude, even sometimes reducing respiratory motion amplitude (3,4).

Aim

To evaluate the potential benefit of a hypnotic recording in reducing artifacts during 4DCT acquisition for lung SBRT, we conducted a monocentric prospective clinical trial, “Hypno-4D”.

Materials and Methods

At the simulation session, at least two 4DCT scans are acquired: the first during normal breathing for treatment planning, and the second under a hypnotic recording. Patient breathing is monitored and recorded using surface imaging to determine the appropriate CT acquisition parameters and to reconstruct ten respiratory phases. After the first 4DCT scan, without further instruction, the patient is inducted into hypnosis for five minutes using an audio recording. The second 4DCT scan is then performed using adapted acquisition parameters. The patient is finally asked to complete a Likert-scale satisfaction questionnaire.
The breathing signal from each 4DCT scan is retrospectively analyzed using a Python program. Based on visual assessment and automatic detection (5), the number of artifacts in the two 4DCT datasets is compared.

Results

Preliminary results from the first patient show reduced respiratory rate (8.8 vs. 10.4 bpm) and thoracic amplitude (4.2 vs. 6.9 mm) under hypnosis (Fig.1). From visual inspection, the median artifact counts at the external surface, diaphragm, and tumor across the ten 4DCT phases decreased from 5, 2, and 0 to 1, 2, and 0, respectively (Fig. 2). Similarly, the average number of artifacts per phase and the number of artifact phases decreased under hypnosis by 31% (3.6 to 2.5) and 33% (6 to 4), respectively, using the automatic detection tool.

Conclusion

Results from the first enrolled patient showed that hypnosis is well tolerated. It regularized respiration and reduced both breathing amplitude and image artifacts.

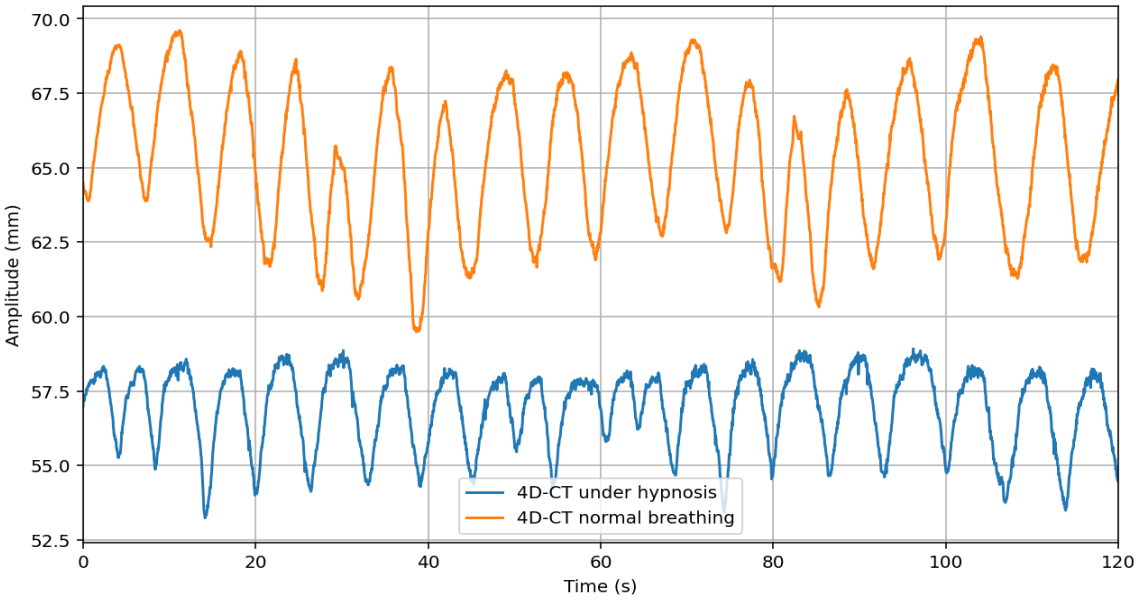

Figure 1: Breathing signals extracted from surface imaging during 4D-CT acquisition.

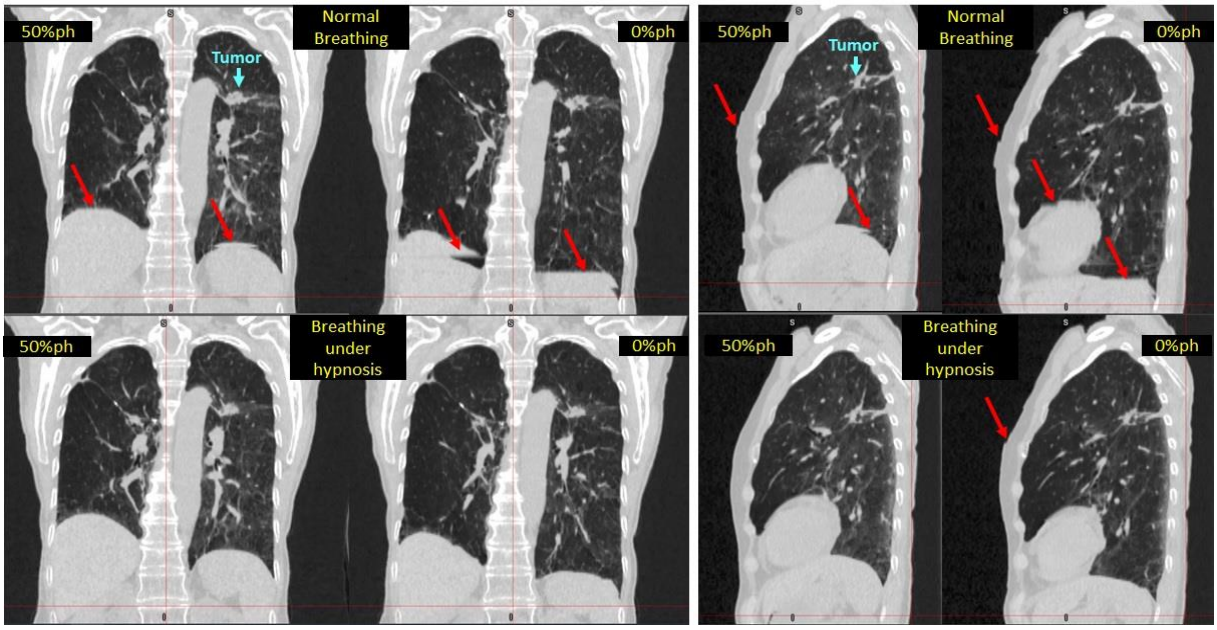

Figure 2: Artifact visual analysis: coronal and sagittal views of the two 4DCT scans acquired during normal breathing and under hypnosis (50%ph corresponds to end-expiration phase, 0%ph corresponds to end-inspiration phase). Red arrows indicate the location of the artifacts.

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